EPA's comments to the State Water Board's Bay Delta Water Quality Control Plan

Background

The role of water in supporting riverine and estuarine ecosystems cannot be separated from the geometry and bathymetry through which the water flows. This was a primary message of the expert testimony to the board in 2010 and was included prominently in the resulting Flows Report. Historical ecology of the delta shows that salinity distributions in relation to flow were very different before the deepening of channels in the western delta, as shown by Robin Grossinger and Alison Whipple in their opening presentation at the workshop on the Low Salinity Zone that EPA held on March 27th, 2012. Large shallow sandbars blocked the upstream movement of salt water and so the delta east of Chipps Island retained its freshwater character almost irrespective of changes in flow. Freshwater wetlands, lakes and sloughs comprised the delta and served to slow the passage of water to the bay, extending freshwater conditions throughout the year. The removal of wetlands, the deepening of channels, the simplification and connecting of channels, and the reinforcement of levees has completely changed the way water interacts with the physical environment in the delta. Although, water project operations have maintained the year-round freshwater nature of Delta waterways, they do not support most of the former ecological functions.

As recently as the 1920s, salinity records indicate that Suisun Bay and Marsh were fresh for most months in most years. Encroaching salinity, because of upstream water development, allowed introduced fouling organisms (*Teredo natalis*) to invade Suisun Bay and inflict severe damage via wood-boring on the infrastructure present at that time. The invasion of saltwater clams and jellyfish into Suisun Bay and the western Delta in response to further salinity encroachment thus continues a long-standing sequence of degradation of beneficial uses in the estuary. The adoption of the Estuarine Habitat (X2) standard by EPA and the SWRCB was an attempt to stop this degradation at the level it was when the Clean Water act was adopted.

In 1992, when the concept of X2 as a regulatory parameter was developed, the modeling of the salinity distribution of the estuary was one-dimensional. Nevertheless, analyses using X2 showed that a wide array of young fish and shrimp demonstrated surprisingly strong correlations with year-to-year changes in X2. These correlations overwhelmed year-to-year changes in food abundance, stock size, or any other factors that would be expected to have significant effects on estuarine organism survival and abundance. Reanalysis of these relationships shows that they generally continue, despite massive changes in the structure of the ecosystem.

Prior to 1992 ecological attention had focused on the low salinity zone as an area where food and organisms accumulated due to gravitational circulation. Hydrodynamic modeling and field studies in the 1990s showed that gravitational circulation was overwhelmed in Suisun Bay by the force of tidal mixing. Studies into mechanisms that could produce the correlations of

organisms to X2 have failed to identify any explanatory single factors. The fact that the organisms that show these responses are as diverse as Pacific Herring, Bay Shrimp and young Striped Bass suggests that multiple factors associated with freshwater flow are involved. The likelihood of multiple causative factors behind the X2 relationships, and the value for management in understanding those mechanisms, was a point of broad agreement at the EPA workshop.

Michael McWilliams presented three-dimensional, fine-scale modeling results using UnTRIM at the EPA workshop. The UnTRIM model covers the entire estuary throughout the delta and west of the Golden Gate. Dr. McWilliams originally performed the analyses to determine the impacts of a proposal to deepen the Sacramento Deepwater Ship Channel; his results showed that the proposed project could slightly increase salinity incursion into the delta. Of greater interest to the workshop participants were that the modeling results allowed a translation of the one-dimensional X2 view of the estuary into a very dynamic and detailed view of salinity distributions. These modeling results clearly showed how changes in delta outflow affect the location, area, and volume of the low salinity zone, where it moved over the course of a tidal day and how different salinities ranges could be found in the wetlands of Suisun Marsh. A simple illustration of the relationship between the new UnTRIM insights with the more historical X2 view of the estuary is reflected in the attached 'flip-book.' Stephen Monismith of Stanford presented his SUNTANS model which is also 3-D, but can deal more precisely with sediment transport and other physical processes. SUNTANS is limited in its processing speed to smaller areas or shorter time periods.

The Estuarine Habitat protective standard (X2)

Twenty years experience with the current X2 regulation to protect springtime location of the low salinity zone has identified a number of issues. Dr. Mueller-Solger found that the calculation used by the projects to interpolate X2 contained a bias that tended to underestimate the effect of flow on X2. The amount of water involved is small, but the ability to compare field data with operational and modeling outcomes was highlighted. Similarly, the fall adaptive management studies by BOR and IEP in 2011 yielded rich results by setting up clear expectations of the ecological effects of changing X2 and gathering much scientific data to test those hypotheses. The preliminary report on these studies will have been peer-reviewed by the time of the workshop and should provide the board with a number of testable and tested hypotheses regarding the ecological processes in the low salinity zone. Such rationales and performance measures should be incorporated into whatever standards the board adopots in its new WQCP.

As the Board reconsiders the springtime X2 standard, EPA suggests a close look at the use of the Roe Island trigger. As the Board is aware, the Roe Island trigger was inserted so that the duration of X2<65 was comparable to what would have been in the early 1970s when the Clean Water Act was authorized. Evidence from the Bay Institute to the Board in their earlier evidentiary hearings suggested that project operations had expanded to the extent that the Roe

Island trigger could be manipulated through project operations, undermining both the frequency of X2 <65 as well as the duration. If the Roe Island compliance point is not implemented as originally intended, the level of variability protected by the X2 standard is much less. On the other hand, the UnTRIM model results suggest that the areas and volumes of the LSZ when X2 is at 74 vs 65 is much smaller than generally believed when the standard was adopted in 1995. Lower X2 values are still associated with higher survival and abundance of a wide range of species, but the improvement from X2=74 to X2 = 65 does not seem explainable by reference to area or volume of the LSZ.

Another aspect of the LSZ that the board should address in the light of new information is the duration and/or onset of springtime protective measures. Intensive studies of both salmon migration downstream and smelt migration upstream is the influence of first flush conditions that change salinity, turbidity and flow conditions in the estuary. Either reconfiguring standards in terms of some measure of 'first flush' or implementing more protective levels before the first flush happens appears to be a more sound basis than the present February 1.

Most attendees of the EPA workshop found that salinity generally, and the low salinity zone in particular is valuable as a regulatory parameter because it directly affects aquatic organisms and is often under control by the regulated community. In addition, all agreed that salinity by itself was inadequate to characterize fish habitat and that other environmental features, including temperature, nutrient loads, turbidity, hydrodynamics, as well as the composition, abundance and distribution of food could all change the quality of habitat for a given species. Most, but not all, attendees agreed with the Board's 2010 expert panel characterization of flow as a 'master variable' because changes in flow will usually change salinity, turbidity, hydrodynamics, nutrient and contaminant loads and most other aspects of the aquatic environment. As stated at the end of the flows report, though, many things can change the relationship of flow with these other parameters. Changes in the physical configuration of the delta, changes in sediment loads from upstream or through the delta, changes in climate will all change the effects of flow on other aspects of fish habitat. The Board should craft standards that can easily change with new conditions and new information, but retain a quantifiable and consistent level of protection for aquatic resources.

Percent of Unimpaired Flow (PUF)

With 'Percent Unimpaired Flow' as the basis for new standards, the Board has begun an approach to the protection of aquatic resources that shows great promise as an over-arching and flexible tool that can also give guidance to long-term water planning. For successful use of the PUF as a regulatory tool the board needs to ensure that measurable environmental conditions are part of the implementation and that the level of protection is greater than has been in place to date.

For example, depending on the level of PUF dedicated to delta outflow, the area and volume of the springtime LSZ may be substantially different than under the present X2 standards. As with the X2 standards, the Board should adopt a level of PUF that provides area and volume of the

LSZ as would have been there prior to 1972. As discussed above, there may be a number of ways to improve protection and the efficiency of protection, but protection must focus on measurable parameters that are relevant both in ecology and management.

2. **Support the approach for designating percentages of unimpaired flows (PUF)**
    a. Employ the PUF approach for achieving upgraded X2 standards (outlined above).
    b. Employ the PUF approach for achieving upgraded protections for beneficial uses on the lower SJR.
    c. Stop using "water year types" as a regulatory tool.
    d. Set PUF for Delta outflows as high as the quantity supported by the SWRCB flow report (2010).

3. **San Joaquin River recommendations**
    a. Set temperature ranges consistent with EPA's 303(d) listing and narrative criteria.
    b. What should we do about the VAMP?

4. **Interior Delta Flows**
    a. Set export restrictions on the SJR to upgrade protections for salmonids.
        (i) Set spring restrictions consistent with Table 15 (CDFG flow report).
        (ii) Set fall restrictions consistent with the 10-day pulse flows specified on Table 22 (SWRCB flow report).

"We got work to do..."

* Dr. Herbold will synthesize key findings from LSZ workshop (3/27/12) – especially areas of agreement and certainty.
* Reprise EPA's regulatory impacts analysis (RIA) from the Bay Delta Accord era to suggest ways to spread-out the responsibility for achieving upgraded protections for WQ.
* Restricting exports (versus increasing reservoir releases) is the best way to achieve compliance with X2 standards.
* Design an adaptive management plan containing specifics and imbued with the precautionary principle that favors beneficial uses.*